WOUND BALLISTICS REVIEW

JOURNAL OF THE INTERNATIONAL WOUND BALLISTICS ASSOCIATION

JFK Assassination

DIFFERENCES IN THE WOUNDING BEHAVIOR OF THE TWO BULLETS THAT STRUCK PRESIDENT KENNEDY; AN EXPERIMENTAL STUDY

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On November 22, 1963 President Kennedy was struck by two 6.5mm fully-jacketed military (Manulicher-Carcano) bullets made (in 1954) by the Western Cartridge Company of East Alton, Ill. These two apparently identical bullets behaved quite differently after striking the President. This fact elicited surprise comments from people who had never done actual duplication experiments with this exact cartridge and proper fresh materials[1].

These highly dependable cartridges were part of a large order from the Italian government (via our Army), when they had decided to refurbish their WWII inventory of rifles. Later, they abandoned this plan and these 6.5mm Carcano cartridges were sent back to the U.S. and to Canada and 'dumped' on the open market, along with large numbers of Carcano rifles. They were bought up and resold at very low prices by gun dealers throughout the west and middle-west, to go with both the original and a shortened version of the Manulicher-Carcano rifle. It was at this time (Jan. 27, 1963) that Oswald ordered his 'shortened" rifle ("carbine") by mail from Kleins Sporting Goods Store in Chicago, for $12.88 (Fig. 1), plus $7.07 for a 4 power Japanese telescopic sight, which was mounted on it by Kleins, using only two of the four screw holes on the mount. This allowed loosening of the telescope after only one hundred of our rounds.

Fig. 1

OSWALD BOUGHT HIS RIFLE FROM THIS ADVERTISEMENT

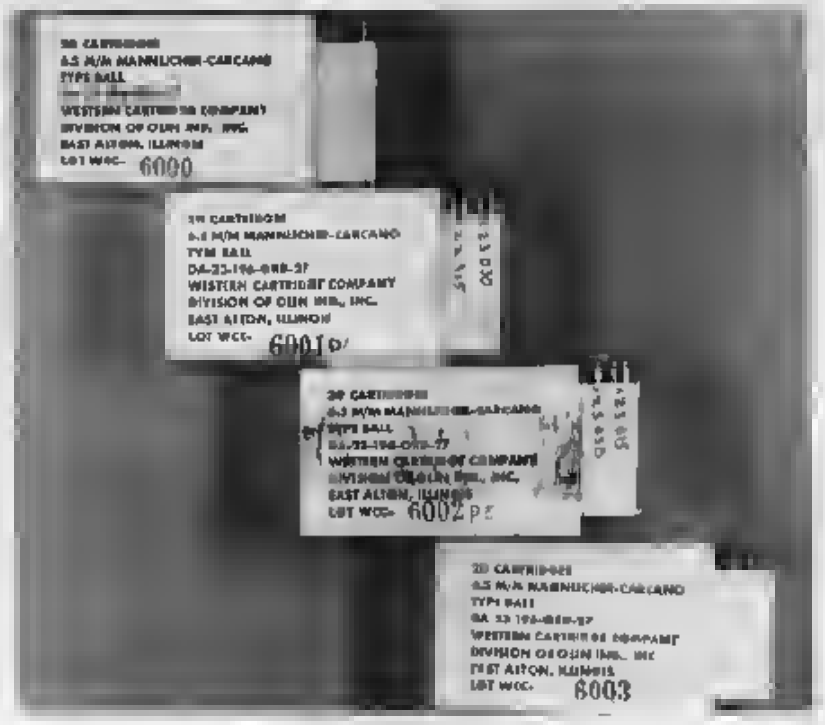
Kleins sporting goods mail order store in Chicago mounted the 4-power "ordnance optics" telescope on his rifle for $19.95 total. Oswald ordered it on January 27, 1963.

WOUND BALLISTICS REVIEW
JOURNAL OF THE INTERNATIONAL WOUND BALLISTICS ASSOCIATION

Fig. 2 :

OSWALD'S AMMUNITION

The cartridges used by Oswald were an excellent American-made Western Cartridge Company produce. Four sub-lots had been manufactured, in 1954 and we tested samples from all four lots. They had excellent consistency of bullet weights and powder weights. We fired about 700 rounds in our experiments, and various government agencies fired about 200 more. We had no misfires, nor did the other groups. The cartridges were sold in boxes of twenty, and it seems likely that Oswald was down to his last four, since no more were found among his possessions. (J.K. Lattimer)



We do not know where Oswald bought his ammunition, but it was widely available in gun shops in the middle-west, in its original cardboard boxes of 20 rounds each (Fig. 2)

There were 4 lots of 1 million cartridges each. We were able to purchase several boxes from each of the four lots, for our tests. Bullet weights (161 grains) and powder charges (44 grains, WC ball, Army lots 40816, 40817) were remarkably consistent. The primers were all sealed with a rim of purple lacquer and neither we nor any of the other groups who tested the ammunition had any misfires, despite its 40 years of shelf life. (A testimonial to the excellence of the American maker).

Our bullets showed a muzzle velocity of approximately 2400 feet per second, with the usual minor variations, even though advertised at 2200 ft/s.

The gilding-metal jackets of these bullets were 0.15mm in thickness, but were open on the rear end of the bullets, so that it was possible for the lead core to extrude through this open end, if the bullet was compressed or flattened (Fig. 3). These lead cores, while physically very similar, had enough chemical differences to permit Prof. Vincent P. Guinn to distinguish lead fragments from one bullet from those of the other, with certainty, using neutron activation analysis[2]. He was also able to determine that there were no lead fragments representing a third bullet.

The penetrating capabilities of this round are excellent. For example, in wood it penetrated 47 inches into a sack of Ponderosa pine boards as shown by Dr. John Nichols. In solid elm wood it penetrates well (25 inches) and does not deform (Fig. 4)

From a "bench rest," our rifle produced groups of 1 1/2 inches in diameter at 263 feet (Fig. 5) which is about what the manufacturer's tests did at 300 feet.

Oswald's rifle score book from the Marine Corps, which is in our collection, shows that while he was no "expert" marksman, he was perfectly competent to do what was alleged at Dallas (Fig. 6).

Fig 3

KENNEDY- CONNALLY
BULLET TESTS

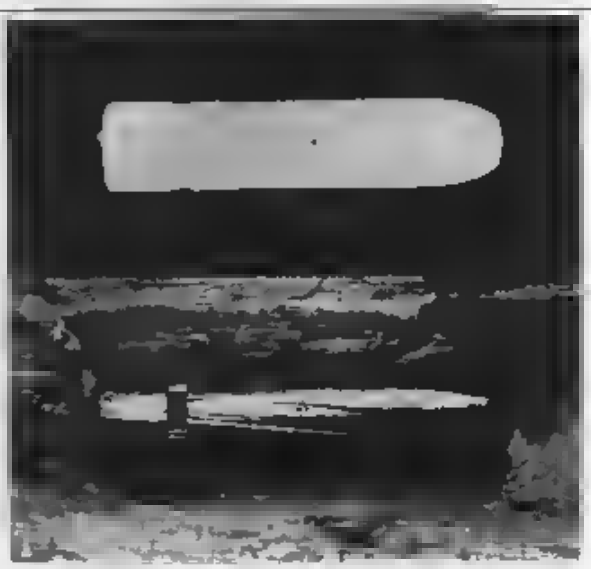
Bullet 399 (left) struck Connally's fifth rib a tangential blow while traveling sideways and was flattened to the same degree as we then flattened our test bullet (right). This flattening caused its soft lead core to extrude from the rear end, some of which can still be seen (arrow). We believe the remainder of the extruded lead was scraped off on the Governor's radius and femur, since the bullet was now traveling almost backward at that point. Neutron activation tests bore this out. The extruded portions of lead from our test bullet weighed exactly 2.1 grains, the same amount as was missing from bullet 399.

Fig. 4

GOOD PENETRATING CAPABILITY;
UNDEFORMED BULLET

X-ray of a bullet like 399 which has traversed 25 inches of a block of the toughest elm wood, before being stopped. The bullet is undeformed. Nichols showed that this bullet can penetrate 47 inches of ponderosa pine boards without being deformed.

The bullet is also seen to be undeformed after it was dug out of the wood. Those who thought one bullet could not go through two men and come out relatively intact, never tried his kind of experiment. (J.K. Lattimer)



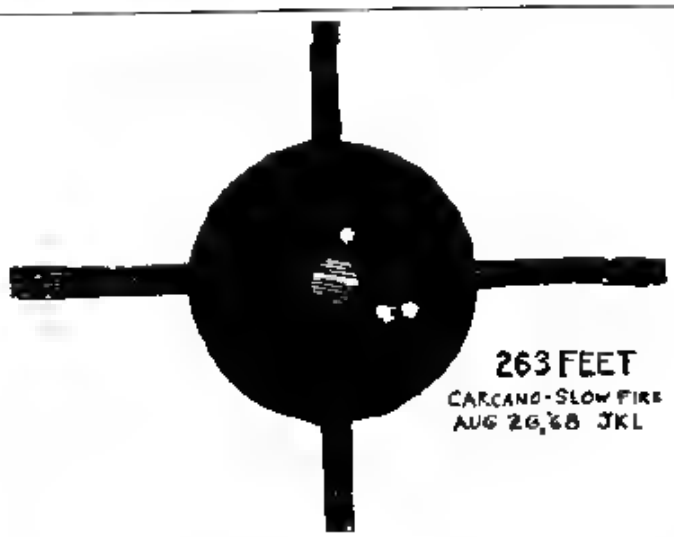


Fig 5:

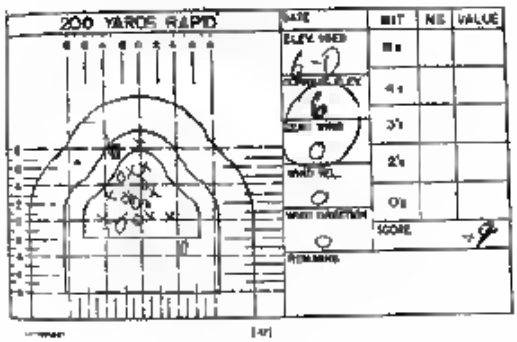
ACCURACY OF CARCANO CARBINE

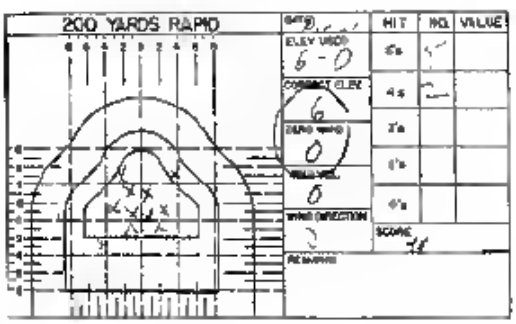
A "bench-rest" target showing the adequate accuracy of the Csicano carbine at 263 feet (the range when Kennedy was wounded in the head), using sling rest, and prepared sitting position, as Oswald did. The group measures 1 1/2 inches across. This is the degree of accuracy achieved by this type of ammunition, in production tests by the Western Cartridge Company (J K Lattimer)

Fig 6.

OSWALD'S MARKSMANSHIP WAS PERFECTLY ADEQUATE TO DO WHAT WAS DONE AT DALLAS

Pages of Oswald's Marine Corps rifle score book show that on a Wednesday (top), he scored forty-nine out of a possible fifty points at a rapid fire from a sitting position at 200 yards (more than twice the distance at Dallas) and did it with no telescopic sight. On the following Friday, he scored forty-eight out of a possible fifty (bottom). From this it is evident that Oswald was definitely marksman enough to have shot Kennedy as alleged. It should be noted that the contour of this target is remarkably similar to that of the head and shoulders of Kennedy as they projected above the back seat of the automobile in Dallas, and that the rifle with which Oswald was trained in the Marine Corps. The author owns this rifle score book and knows it is in its original condition (J K Lattimer)





Our 14 year old team member (DGL) had no trouble putting 3 bullets in Kennedy's head, firing at Oswald's 5 second intervals (Fig 7)

In fresh soft tissue, (such as President Kennedy's neck) it penetrates easily, causing the usual soft tissue "cavity" (like a large bubble) after a few inches of penetration (Fig 8)

Entry wounds were punctate, about 1/4 inch in diameter, with a rim of blackened specs from the rapidly spinning bullet (Fig 9) If exit wounds were "buttressed" (supported) by a shirt collar, as in Kennedy's case the exit wound was the same small size as the entry wound (Fig 10) The bullet nicked the side of JFK's necktie knot, leaving a blood stain on it (Fig 11) If the next test torso was now tilted slightly, to permit the bullet to exit even 1/2 inch, below the collar band, the exit wound was larger If the exit was one inch from the support of the collar band, the exit wound was much larger (Fig 12)

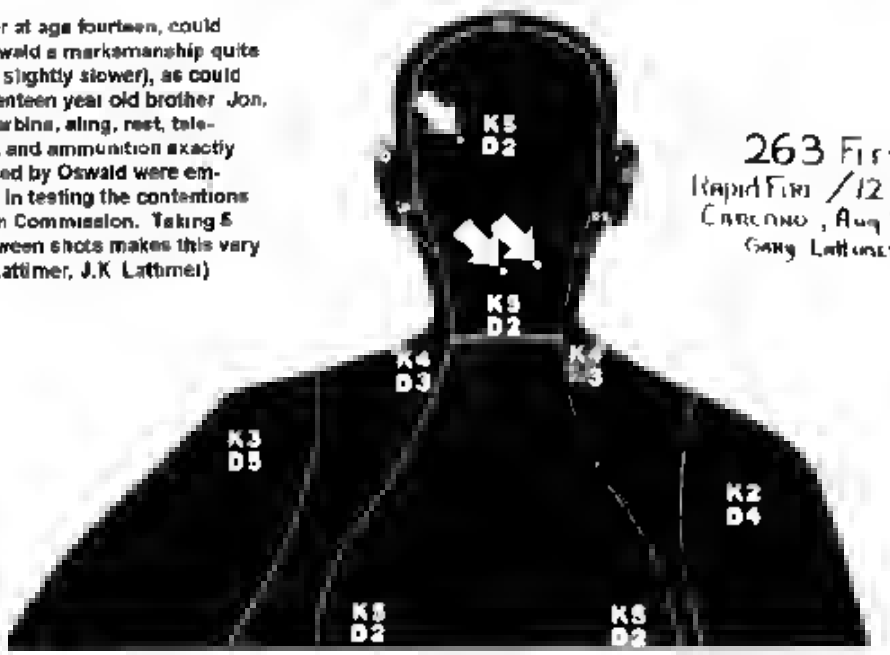
The smallness of the exit wound in the neck was a source of much confusion The actual exit wound was cut across for the prompt tracheotomy which was done at Parkland Hospital in Dallas as part of the essential desperation measures necessary to ensure an adequate airway The bullet goes straight through two men in the Kennedy-Connally positions There is no "zig-zag" (Fig 13)

When the 6 5mm Carcano bullet leaves the soft tissue of the neck it starts to yaw in the air (yaw is the deviation of the bullet's long axis from its line of flight Fig 14 A,B,C) It is not unusual for even these long slender round nosed bullets, which tend to be more stable (remain point forward) in soft tissue than shorter bullets with pointed noses, to be "destabilized" by passing through a soft tissue target The 6 5mm Carcano is still a favorite European sporting cartridge The recoil is not severe, making it an easy gun to shoot

Fig. 7:

NOT A DIFFICULT SHOT

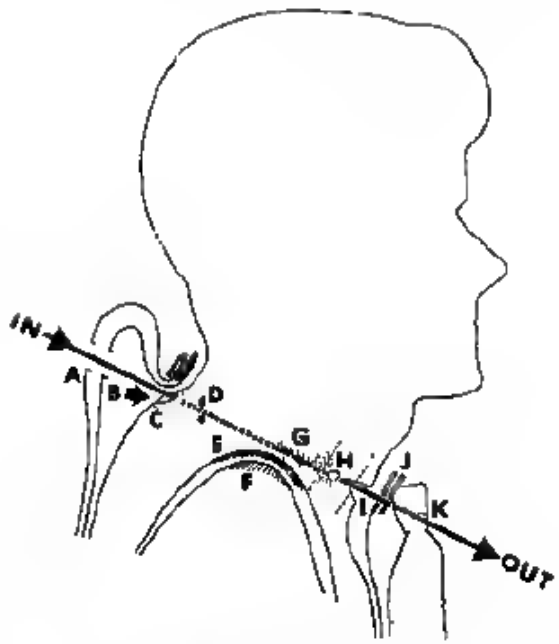
Gary Lattimer at age fourteen, could duplicate Oswald s marksmanship quite easily (albeit slightly slower), as could his then seventeen year old brother Jon. A Carcano carbine, sling, rest, telescopic sight, and ammunition exactly like those used by Oswald were employed by us in testing the contentions of the Warren Commission. Taking 5 seconds between shots makes this very easy (I.E. Lattimer, J.K Lattimer)



WOUND BALLISTICS REVIEW
JOURNAL OF THE INTERNATIONAL WOUND BALLISTICS ASSOCIATION

Fig. 9.

LATTIMER DRAWING FROM ACTUAL X-RAY OF PRESIDENT KENNEDY'S BODY



This diagram of the neck wound is based on personal observations of the photographs and X-rays. Because the National Archives requested that no tracing be made, it is not precise. Its purpose is to clarify the relative positions of the wounds in the neck and the various findings which together indicate that all were consistent with entry of a bullet into the upper back that ranged downward and medially through the base of the neck and exited low on the trachea in the midline, just below the collar button, causing a nick in the knot of the necktie. The findings were:

A. Bullet Hole in Back of Suit Collar and Shirt. The coat and shirt were probably bunched up on the back of the President's neck when the first bullet struck him. The FBI found a punched in round hole in the back of the coat consistent with 6.5mm bullet, with the broken cloth fibers bent inward, indicating that this was a wound of entry. The cloth fibers of the shirt were bent inward in the same manner. Traces of copper from a bullet such as Oswald used were found on the margins of this hole in the coat by the FBI, also indicating that it was a wound of entrance.

B. Bullet Hole in Back. The bullet hole in Kennedy's upper back, about two inches below the crease of his neck, and about two inches to the right of the midline. It was actually on the large fat pad high on the back of his neck from all the cortisone he was taking. This places it at the level of his jaw bone, well above the wound of exit.

C. Halo around Bullet Hole. The bullet hole had around it a faint but definite halo, or circumferential abrasion, typical of a wound of entry from a bullet.

D. Spine grazed by Bullet. Tiny slivers of bone could be seen in the upper (rear) area of the bullet track on the A-P X-ray film of the right shoulder and neck area. Since no lateral X-ray film was taken of this area it is possible to determine only that they lay near the high (rear) end of the bullet track, but not the exact distance they lay from the surface. They were near the tip of the transverse process of the cervical vertebrae, which the bullet obviously grazed. They are represented diagrammatically only.

E&F. Pleura and Lung Bruised. The autopsy report described a 5 cm bruise on the dome of the right pleura and also on the upper tip of the right lung, but no perforation of either, compatible with the passage of a high-speed bullet close above this point.

G. Air in Tissues. There were tiny traces of air, visible in the X-rays, in the tissues along the bullet track, near the hole in the trachea.

H. Hole in Trachea. There was a ragged hole in the right side of the trachea, seen by the surgeons at Parkland.

I. Tracheostomy. There was a gapping 5.5 cm transverse tracheostomy incision low on the neck where the Dallas surgeons had enlarged the bullet hole in order to insert a tracheostomy tube.

J. Holes in Front of Shirt. There were 1 cm vertical slits in both sides of the overlapping portion of the shirt immediately below the collar band and touching it just below the collar button.

K. Nick in Necktie. There was a nick or crease through only the outer layer of fabric of the lower left side of the knot, compatible with the passage of a spinning 6.5 mm bullet at high speed. A bloodstain extended downward from this nick.

(J.K. Lattimer and James Lattimer, Resident and Staff Physician, May 1972)

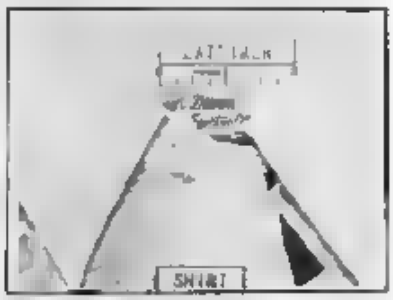
Fig. 9:

BULLET HOLE IN THE BACK OF OUR KENNEDY MODEL NECK

Photograph of an actual entrance wound made by a 6.5mm fully jacketed Carcano bullet in the skin of the back of one of our "Kennedy" necks. It is about one-quarter inch in diameter. Note the abraded edges with black particles on the margins. The wound on the back of Kennedy's neck looked much like this. (J.K. Lattimer, Michael Macfarlane)

Fig. 10.

BULLET EXIT HOLES IN SHIRT



We were able to duplicate the wounds of entry and exit in models of Kennedy's neck, using the exact type of Carcano rifle and Western Cartridge Company ammunition that Oswald used, and an aiming point on the shirt that permitted the bullet to exit in the same spot at the lower edge of the collar band as in the case of Kennedy. This resulted in a vertical slit in the cloth starting at the lower edge of the collar band, exactly like that in Kennedy's shirt. The bullet then continued to tumble after it left the neck, striking our models of Connally, twenty-eight inches away, now traveling almost precisely sideways, with great consistency. (J.K. Lattimer)

Fig. 11:

BULLET GRAZED NECKTIE AFTER EXIT FROM FRONT OF NECK

Our duplication of Kennedy's neck wound resulted in a duplication not only of his shirt and skin wounds but also of the nick in the left side of the knot of the necktie, exposing the lining. The necktie at left is the actual bloodstained necktie worn by Kennedy and the necktie on the right is our test tie. (Left: National Archives, right J.K. Lattimer)

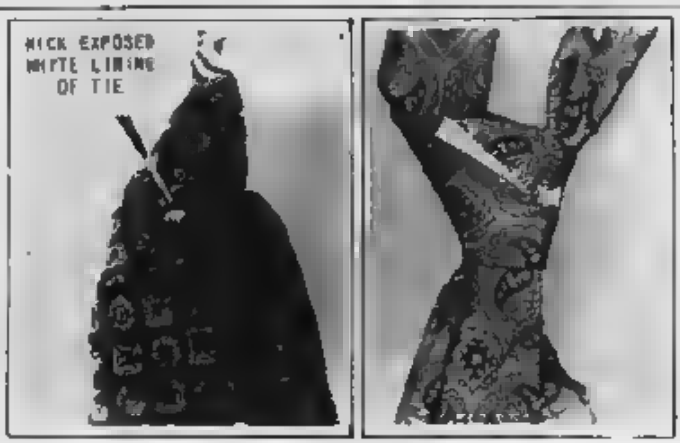


Fig. 12:

THE SMALL NECK WOUND IN FRONT OF THE NECK

The smallness of the exit wound in the front of Kennedy's neck has been a point of debate from the very beginning. Critics claimed it was so small that it must have been a wound of entrance, implying another shooter firing from the front. Experimental studies, reported by us for the first time, revealed that the support of the president's collar band was undoubtedly the reason the wound of exit on the front of his throat was not larger. As this support was moved away, the exit wound became larger and larger. (J.K. Lattimer)

Fig. 13.

KENNEDY AND CONNALLY STRUCK BY THE SAME BULLET

The white line in the photograph shows the straight course of bullet 399 through both men; first through the neck of President Kennedy in the rear seat, as his head was turned to his right, while waving to the crowd. Governor Connally, seated directly ahead of him, had heard the first shot, which hit a tree and missed the automobile completely, and was trying to twist around to look directly backward to see the President. He found that in spite of leaning far over to his left, and then placing the heel of his right hand against his left thigh to push, he was still unable to twist far enough around to see back over his right shoulder. He held his brown brimmed white Stetson hat in his hand, upside down, as shown. Bullet 399 then struck him in the right side of his back because he was twisting over so far to his left. It shattered his fifth rib, while going sideways and a little backward. It then exited just below the right nipple, went through his right wrist and travelling backward, embedded itself in the skin of his left thigh. Being a long bullet, it was knocked out on his stretcher later. No zig-zag course was followed. (Note. Connally was actually seated in a jump seat that was actually much lower than the President's seat.) (J.K. Lattimer, Gary Lattimer, M.M. Macfarlane, J.T. Donovan)

Fig. 14

NECK BULLETS TUMBLE AND WOBBLE AFTER LEAVING KENNEDY NECKS

A neck bullet tumbles end-over-end (dependably) on leaving a Kennedy neck. It also wobbles (precesses) from side-to-side. These screens which stood between 3 of our sets of Kennedy necks, Connally rib cages and Connally wrists, from three of our Kennedy-Connally "mockups," show the variations in shape and orientation of the bullet holes after passing through a Kennedy neck, a Connally rib cage and a Connally wrist. These explain the variations in the sizes of the exit and entrance wounds in Connally's back and in the two sides of his wrist. The bullet was still tumbling after traversing his rib cage and his wrist. It then went backwards into his thigh, where it made a more punctate wound, from which it fell out onto the stretcher.
(J.K. Lattimer)

The first bullet (WC 399) to strike the President, yawed when it left his neck, as our experiments have demonstrated on many occasions[1] It had hit him on the thick elevated, soft fat-pad on the back of his neck (caused by his cortisone intake) and created a soft-tissue cavity much like a bubble, as we said earlier, in the right side of his neck. This cavity might have traumatized the web of nerves that supplies the right arm (called the brachial plexus) and jarred his spinal cord severely The closest muscle served by these nerves was the President's right deltoid muscle (via his axillary nerve) This caused his right upper arm and elbow to jerk up instantly. The next closest muscle to be stimulated was the right biceps muscle, via the musculocutaneous nerve causing his lower arm to flex towards his face The farthest arm muscles where the flexors of his wrists and fingers which then clinched his hands, (now up in front of his face) as the impulse traveled down his median nerve

As the shock wave from the impact spread across the mid line to his spinal cord and to the left side, his left arm then came up, then his left biceps contracted and then his left wrist and fingers clinched, just as on the right side, but more slowly, because of the greater distance across to the left side The position his arms achieved due to the spinal trauma in this area was described by Thorburn, 100 years ago, in the English literature, and which I have called "Thorburn's position" (Fig 15 A&B) It reflects (A) the blow to the spinal cord in this area of the C-6 or C 7 (lower neck) spinal segments and the addition, (B) direct trauma to the nerves which leave these segments (brachial plexus) to actuate the arms The shock to the spinal cord at this level might have left the President a quadriplegic for at least several days

As the shock spread down his spinal cord from the neck level of C-6 and C-7, his intercostal (rib) muscles (for breathing) then might have been paralyzed, at least for a time His vagus nerve which influences the heart beat and his right phrenic nerve (controlling the diaphragm) might have been severely traumatized further embarrassing his breathing and influencing his heart beat As the impulse spread to the other side, his left phrenic nerve might also have been affected.

This neurological trauma, plus the tracheal bullet wound leaking contaminated air into the "closed space" of his mediastinum, in a man full of cortisone for his atrophied adrenal glands, could have been fatal. (Cortisone reduces your resistance to infections) We postulated this in 1980[3] Neurosurgeon Dr Kenneth Strully has concurred in this This wound was overshadowed, of course, by the much more dramatic massive brain wound, five seconds later

Performing right on schedule, this intact bullet, as it left the neck, began to yaw, (Fig 16) striking Governor Connally while traveling sideways, whose back was some 28 inches in front of the President, sitting in the jump seat of the open touring car, well below the level of the President Connally had been alarmed by the first shot and had been twisting around to his right in an effort to see the President over his right shoulder, so that the bullet struck him on the right side of his back. When one tries to look backwards over the right shoulder, in a jump seat of such an automobile, one shifts over to the left in order to try to turn around Connally was in this position when he received the wound of entrance in his back, measuring exactly 3cm in length (Fig 17) This was the exact length of the bullet, indicating that it was now travelling sideways in its yaw rotation (confirmed in our experiments, Fig 18) It now struck Governor Connally's fifth rib, smashing a 5cm segment into dozens of tiny sharp rib fragments which now exited in a cloud of bloody soft tissue, with the bullet below the right nipple of Governor Connally (Fig 19) The cloud of rib fragments bulged out his coat jacket on the right side and caused his right lapel to turn over, covering his shirt front for an instant in frame 224 of the Zapruder movie (Fig 20)

Still yawing, bullet 399 now struck Governor Connally's right wrist, in which he had his large white Stetson hat He was using the heel of his right hand to press against his left thigh in an effort to try to augment his turn to the right to look over his shoulder The bullet made a 2cm wound on the back of his wrist but by the time it exited his wrist the wound was still smaller, because the bullet was still yawing Since it hit the wrist while now going somewhat backwards, the extruded lead on the back end of the bullet (Fig 21) (as a result of the rib struck) was now scraped off on the bone of Connally's radius Three such fragments were seen by x-ray (Fig 21) and removed at an operation almost immediately by Dr Gregory These were shown later by neutron activation analysis to match the lead core of bullet 399[2] Governor Connally's radius was broken completely across at this point, creating several small comminuted fragments of bone The lead core

had been squeezed out of the rear end of the bullet by striking Connally's rib while traveling sideways just as toothpaste might be squeezed out of a tube by compressing the tube on the side (Fig 22) These lead fragments were found by neutron activation analysis not only to match bullet 399, (the neck bullet) but to be distinctly different from the fragments of lead from the head bullet, which we will describe later[2] Our yawing experimental bullet also fractured our "Connally" radius and left particles on the bone (Fig 21)

If the experimental bullet did not traverse President Kennedy's neck first (to make it yaw), no rib fragments occurred, so there was no lapel bulge (Fig. 23)

Bullet 399, now traveling almost completely backwards, embedded itself in the muscles of the upper leg of governor Connally Here it left a fourth tiny fragment of lead (never recovered) It did not fracture the femur, since it had been slowed down by the President's neck, Governor Connally's rib and wrist bones, as well as the soft tissues of his chest, and the clothing of both men, before it struck Governor Connally's leg

Fig 15 A

THORBURN'S POSITION

Illustration from Dr. William Thorburn's 1889 article "Cases of Injury to the Cervical Region of the Spinal Cord " showing the peculiar position assumed by elbows immediately after an injury to the spinal cord in the lower neck region This was confirmed at autopsy shortly thereafter This is the same position into which Kennedy's elbows flew after bullet 399 passed through his neck grazing the tip of the traverse process of a vertebra in the lower portion of his neck and obviously transmitting an impulse to his spinal cord to cause this unopposed contraction of his deltoids, followed by his biceps and hand flexors. (Drawing reproduced by courtesy of Charles Griffin and Company Limited)

Fig 15 B.

KENNEDY IN THORBURN'S POSITION

This drawing shows Kennedy's elbows and forearms elevated and tightly flexed after his spinal cord was jolted severely in the lower cervical region by the transmitted impulse from bullet 399 This bullet grazed the tip of one of his vertebrae in the lower cervical region as it went through his neck His hands are in front of his face He is not reaching for the bullet hole in his neck, as has been so often alleged His elbows remained tightly flexed and held high for the next five seconds, until his brain was shot away in frame 313. The spinal trauma might have left him quadriplegic, at least for a time, and the trauma to his vagus and phrenic nerves might have made this also a fatal wound. (J.K. Lattimer)

WOUND BALLISTICS REVIEW
JOURNAL OF THE INTERNATIONAL WOUND BALLISTICS ASSOCIATION

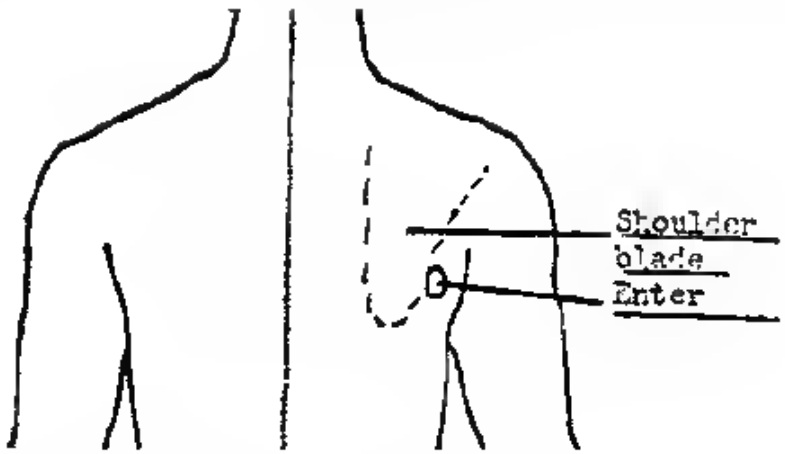
Fig 16

THE PATH OF BULLET 399

A row of 6.5mm Carcano bullets was glued to a strip of Lucite to show the positions of bullet 399 at various points in its flights through Kennedy and Connally, as determined by the size of the bullet holes. Visualizing the bullet's path in this way made it easier to understand why the lead fragments were found only toward the end of its rotation when the bullet was then traveling backward through Connally's wrist. These bullets almost always tumbled under these conditions.

A. The wound of entry into the back of Kennedy's neck was almost round and approximately 6.5mm in diameter (1/4 inch), with a black rim characteristic of a wound of entry. The bullet then grazed the tip of a vertebra in the President's neck, knocking off bits of bone.
B. The wound of exit from Kennedy's neck was destroyed by the tracheostomy incision but was not very large (according to testimony of Dr. Perry).
C. The wounds of exit in the front of Kennedy's shirt were 1/2 inch long in a vertical direction, in both layers of the overlapping part of the shirt front.
D. The wound of entry into Connally's back was 3cm long (1 1/4 inches, the exact length of bullet 399) and was approximately twenty-eight inches away from Kennedy's neck, indicating that the bullet had yawed 90°.
E. The wound of exit from the front of Connally's chest below the medial to his right nipple, was large and jagged, measuring about 5cm in diameter.
F. The wound of entrance into the top of Connally's wrist measured three quarters of one inch in length, showing that the bullet was now turned almost entirely around, so that it was now traveling almost backward. It shattered his radius and left three fragments of lead in it, scraped off from its open rear end, where the lead was exposed.
G. The wound of exit from the underside of Connally's wrist measured only one-half inch in length. (The bullet was still turning.)
H. The wound of entrance into the top of Connally's left thigh measured about three-eighths of an inch and looked punctate, indicating that the bullet had practically completed its 180-degree yaw. One fragment of lead was left in this wound. (J.K. Lattimer and Jamie Lattimer)

Mr Specter Would you draw Dr. Shaw, right above the shoulder as best you can recollect, what that wound of entry appeared at the time you first observed it? Would you put your initials right beside that?
(The witness, Dr Shaw, complied with the request of Counsel Specter)



Mr Specter As to the wound on the back of Governor Connally, was there any indication that the bullet was tumbling prior to the time it struck him?
Dr Shaw I would only have to say that I'm not a ballistics expert but the wound on his chest was not a single puncture wound it was long enough so that there might have been some tumbling.
Mr. Specter. You mean the wound on his back?
Dr. Shaw The wound on his back—yes, it was long enough so that there might have been some tumbling. In other words, it was not a spherical puncture wound.

Mr. Specter. You say the hole which appears on Governor Connally is just about the size that it would have been on his body?
Dr Shaw Yes, it is drawn in good scale.
Mr Specter. In good scale to the body?
Dr. Shaw Yes.

Fig 17

DR SHAW'S TESTIMONY

Dr Shaw initialed and described his careful drawing depicting the wound of entry into Connally's back showing it as 3cm long. He later attested to its accuracy under oath. (Warren Commission Report, Volume Six, Pages 88 and 95 (text) and Volume Seventeen, Page 336, Exhibit 679 (drawing), National Archives)

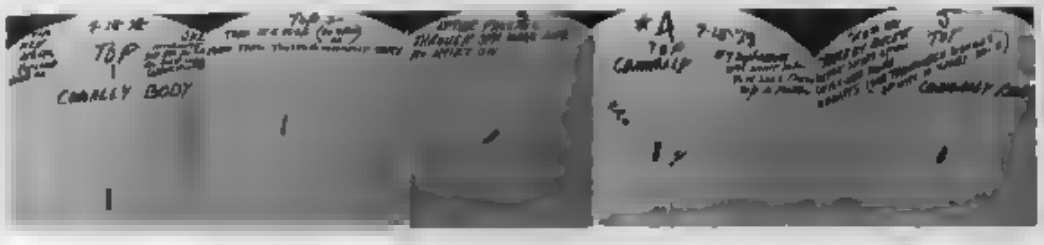


Fig 18:

YAWING OF CARCANO BULLETS AFTER STRIKING KENNEDY NECKS

Five cardboard skins simulating Governor Connally were placed the same distance from Kennedy's neck as Connally was seated in the automobile in front of the President. The Carcano bullets that made the holes in these targets had passed through a simulation of Kennedy's neck, striking only soft tissues. Five of the six bullets yawed 90° after leaving the neck and struck Connally's skin traveling almost sideways. Only one bullet failed to yaw (4A). Four of the bullets yawed in a vertical plane, whereas number 3 yawed in an almost horizontal plane. The presence or absence of a shirt collar and neck tie made no difference in the amount of deflection or yaw. These results confirmed our previous observations that these bullets almost always yawed after passing through a neck. (J.K. Lattimer)

Fig 19:

SEGMENT OF "CONNALLY" RIB REMOVED (SHATTERED) BY YAWING NECK BULLET

The rib wound caused by our yawing Carcano bullet in our Connally mockup. The blast of fragments from this rib bulged out of the jacket and turned over the right lapel as seen in Fig. 20. If the bullet had not hit Kennedy and therefore not been yawing it would not have created this jacket bulge nor this large rib wound, as additional experiments showed. (see Fig. 23)

Fig 20:

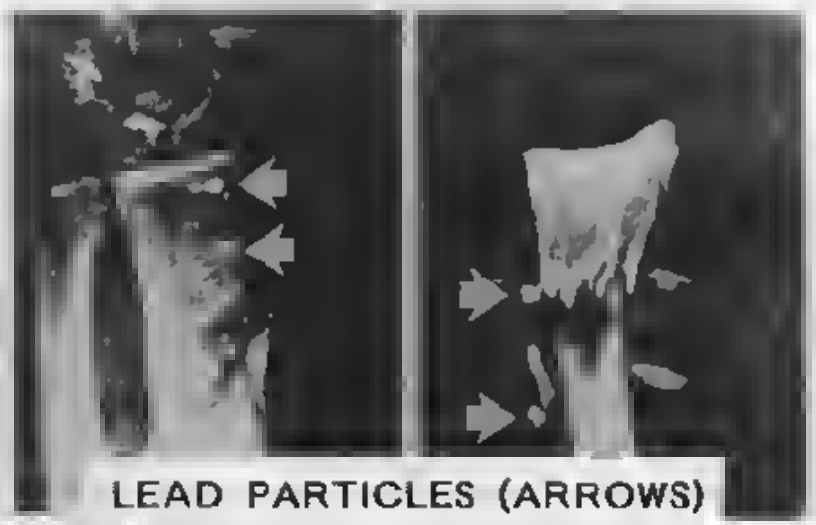
LAPEL AND JACKET BULGE (FRAMES A & B)

As our bullet 399 passed through our Governor Connally simulation, the jacket front was bulged out at least 6 inches by the blast of rib and soft tissue fragments which exited with the bullet. Some of this debris can be seen hanging in the air in front of Connally. He said he looked down and saw his front covered with blood and realized he had been shot "through-and through," possibly fatally. In frame B from this composite the turned-over lapel can be clearly seen snapping back to its normal position after one tenth of a second. This bulge occurs in frame 224 of the Zapruder movie. The right arms of both Kennedy and Connally react immediately and simultaneously, marking the moment they were both hit, by bullet 399.

Fig 21:

CONNALLY'S WRIST WOUND SIMULATED

Our radius (wrist bone), which was mounted in front of the lapel of "Connally's" jacket, was struck about where the Governor's radius was struck but more centrally. Tiny fragments of lead (arrows) were scraped off the extruded soft gray lead at the bottom of the tumbling bullet and were left in the wound of the wrist, as with Governor Connally's wrist. The bullet, which we caught in our bullet trap, was somewhat flattened and bent and had soft gray lead protruding from the rear end of it, like bullet 399. The roentgenograph of our test wrist is mounted beside the roentgenograph of the wrist of Connally for a comparison showing the fracture and the fragments of lead (arrows) in each case.



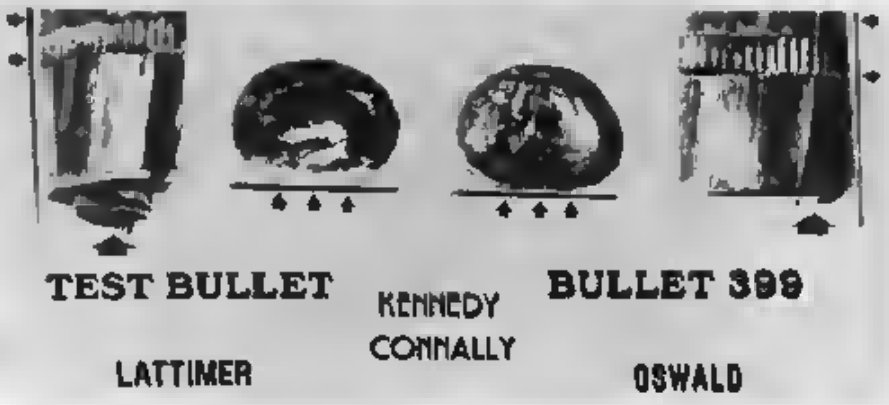


Fig 22:

THE NECK-RIB-WRIST BULLET IS ALWAYS DEFORMED

The flattening of the base of our bullet (left) from striking our "Connally" bones was very much like that of Warren Commission bullet 399 (right). Note the protrusion of the soft lead core of our bullet (left, large arrow) and of bullet 399 (right, large arrow) More of the lead from bullet 399 was scraped off in Governor Connally's wrist and leg than in our simulation. Also note that both bullets are bent (side arrows). These bullets (like 399) are never "pristine' after hitting hbs, while travelling sideways.

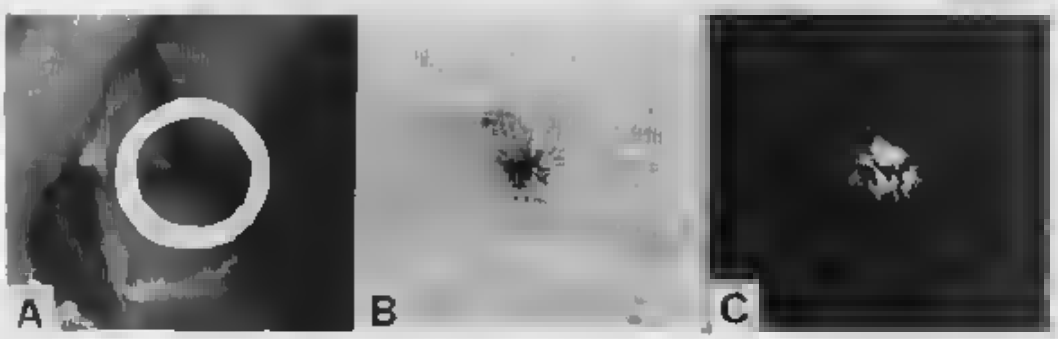


Fig 23

DIRECT HIT ON GOVERNOR CONNALLY GAVE NO JACKET OR LAPEL BULGE

If the bullet did not traverse President Kennedy first, no jacket or lapel bulge occurred. The resulting rib wound was smaller (A), the exh holes in the front of Governor Connally's shirt (B) and jacket lapel (C) were tiny, if caused by this bullet, which struck Governor Connally directly without hitting President Kennedy's neck first. Therefore, the bullet was not tumbling (from hitting Kennedy first), so it did not shatter the Connally rib, causing the hundreds of sharp flying bone fragments. Therefore, it did not bulge the lapel of the jacket worn by Governor Connally. This affirms the fact that bullet 399 had to hit both men to cause the bulge of the lapel in the governor's jacket, which can be seen so clearly.

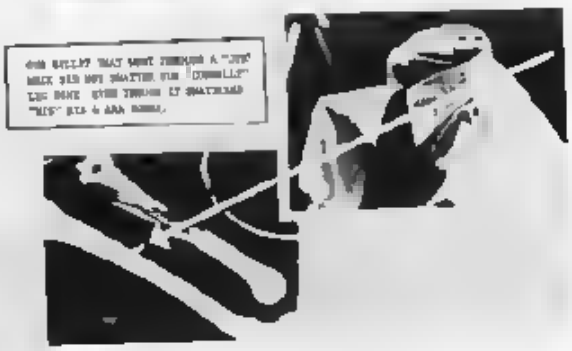


Fig 24:

PASSING THROUGH A NECK SLOWS THIS BULLET DOWN

Above: Our experimental Connally leg bone (bottom bone in these pictures), called the femur, (the largest bone in the body), was always shattered, after our Connally rib (top bone) and arm bone (middle) were traversed if the bullet had not been slowed down by going through a neck first. (J K. Lattimer)

Below: When the bullet traversed an experimental (JFK) neck, it was slowed down, it tumbled and did not shatter the leg bone. Since Connally's leg bone was not shattered, the bullet that hit him must have hit something else first, such as Kennedy's neck, to slow it down. (J K. Lattimer)

This bore out our earlier experimental findings, wherein a bullet that struck and shattered a Connally rib first and then a Connally wrist, would also shatter a Connally femur (leg bone) However, if the bullet had first traversed a neck, (like that of President Kennedy) and then a Connally rib and a Connally wrist, it would not shatter the Connally femur (Fig 24) (This is exactly what happened at Dallas, in that Connally's leg was not shattered by bullet 399) It had been slowed down by traversing the President's neck. This indicated that bullet 399 had hit both men

Different Behavior of the Head Bullet (WC 567-569)

By contrast, the performance of the bullet (WC 567-569) that now (5 second later) hit President Kennedy on the back of the skull, at frame 313 of the Zapruder movie, was strikingly different from the behavior of bullet 399 The reason for this marked difference was the fact that bullet WC 567-569 first hit the hard bone of the back of the skull of President Kennedy and broke up

The greatly increased surface area of the broken bullet and its fragments caused a large temporary cavity to occur in the semi-fluid brain, which, being confined in the cranial vault exploded upward and forward, out the huge wound of exit on the front-right of the skull caused by diverging bullet fragments Our replications demonstrated this "upward and forward" movement of the skull fragments and brain tissue (Fig 25)

The lead core and the gilding metal jacket separated on contact with the skull, (Fig 26) leaving a 6 5mm fragment sheared off by the sharp edge of the bone at the point of impact. The entry wound on the inside of the skull showed the typical "beveling" of the inner end of the skull wound, where the hole was much

larger than that of the outer end of the wound, as is characteristic of wound-of-entrance in bone. The broken bullet scattered dozens of tiny fragments of lead along the track of the bullet from back to front through the brain (Fig. 27). Fragments several millimeters in diameter were embedded in the inner surface of the front side of the skull, adjacent to the bullet track (Fig. 28 AP & LAT). All the fragments of lead removed from the President's head and found on the floor of the Presidential automobile, matched this bullet and not bullet 399. There were lead fragments from 2 bullets and 2 bullets only, by neutron activation analysis[3].

A "beveling" of the wound of exit on the front of the skull was also observed and 3 segments of skull could be seen in the Zapruder movie, spiraling upward and forward away form the head, with a cloud of exploding brain substance, immediately after the impact, just as in our experimental replications (Fig. 25). These flew 40 feet in the air and were recovered from the pavement and infield, later.

Almost the entire right hemisphere of the brain was removed by the bullet (Fig. 28 A&B, 29 A&B, 30). This is exactly what our test bullets did when we replicated the skull and brain wounds on our experimental models. Fragmentation of our skulls was extensive in every case, (Fig. 31,32) with upward and forward ejection of brain material and skull fragments, just as shown in the Zapruder movie in frame 313 and subsequent frames (Fig. 25). This difference in reaction after impact on bone, in contrast to the impact on soft tissues, was consistent. It happened dependably in our replication (Fig. 25).

Retro-recoil of the Head

Backward retro-recoil of the skulls, towards the gun, then occurred in our simulations, just as in JFK's case. Dr. Luis Alvarez had demonstrated this reaction, using melons, earlier[4]. Our experiments with skulls and Oswald-type bullets, verified his findings (Fig. 33).

Fig 25.

SECOND BULLET STRIKES THE HEAD

Upward and forward motion of the brain substance and skull fragments is seen in high speed motion pictures of one of our heads exploding. The source followed is almost a duplication of that of the President's brain and skull exploding in frame 313 of the Zapruder movie. Fragments of skull and a cloud of brain tissue can be seen, driven forward and up, away from his head, by the impact of the bullet. The pieces of skull can be seen ten or twelve feet in the air in frame 313, but they flew thirty or forty feet in the air during our experimental replications of this event (seen here) and probably flew as high as this in Dallas. The cloud of vaporized brain tissue that occurred in our experiments was so large that it is not surprising that, in the actual event, the motorcycle police escort, just behind the car, rode forward into this cloud of exploded brain tissue, which wet their fronts as it descended. Governor and Mrs. Connally both spoke in their testimony about being spattered with Kennedy's brain tissue, in fragments as large as a fingernail. (J.K. Lattimer)

Fig 26

SKULL BULLETS

Top: The two largest fragments of the bullet (top) that struck Kennedy in the head, separated into an empty copper jacket, left, and a lead core, right. The jacket bore markings from the rifling of Oswald's rifle, showing that it was fired from this rifle, to the exclusion of all other rifles. Both fragments were found in the front-seat area of the presidential automobile, apparently having struck the inside of the windshield and its frame at greatly reduced velocities before dropping. Other tiny fragments were found in the President's brain case and on the floor under the jump seat of the automobile. Neutron activation tests showed that all these came from the same bullet that struck the President's head. Still other fragments are shown to have flown over the windshield and struck the ground or pavement ahead of the car. The lead cores usually separated from the copper jackets, as in Oswald's head bullet (top). Olivier's head bullet (middle) and Lattimer's head bullet (bottom). Striking the hard bone of the skull first, disrupted the bullet. Numerous tiny particles of lead also occurred on impact with the skull, leaving a trail of particles in the right half of Kennedy's head, (see Fig. 27 and Fig. 29). All three bullets were 6.5mm Western Mannlicher-Carcano rounds. (Bottom; J.K. Lattimer, others, National Archives.)

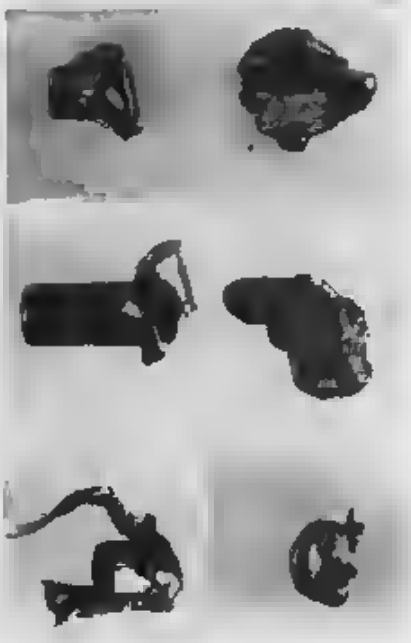
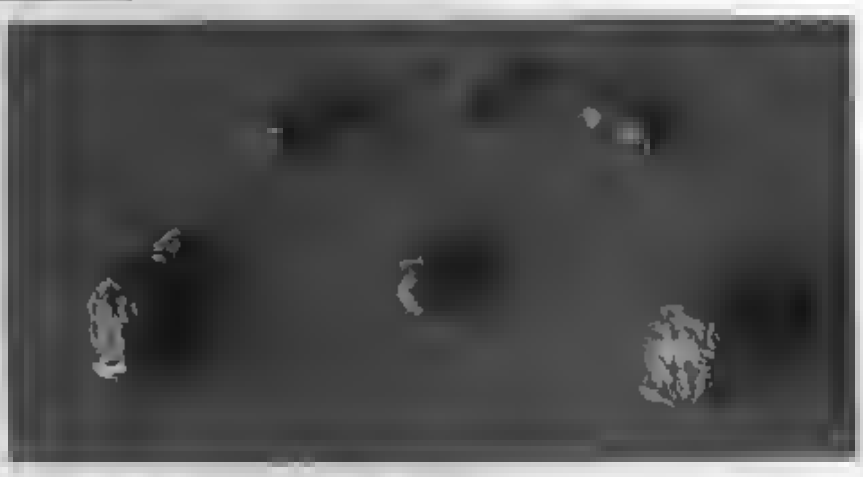


Fig 27

SKULL BULLETS FRAGMENTED

Many tiny particles of lead from the disintegrated bullet core were deposited in the right side of JFK's brain case (Fig. 24) and in our skulls and bullet traps. Many additional particles were like grains of sand, seen in x-rays of our bullet traps. (J.K. Lattimer)



CARCANO FRAGMENTS - JFK SKULL 1

Fig 28 A:

KENNEDY'S HEAD
X-RAY FROM THE
FRONT

Computer-enhanced X-ray of Kennedy's skull seen from the front showing the defect in the top-front of the right side of his head. There are extensive fracture lines radiating from the point of entrance. The white dots are bullet fragments, the largest of which is close to the point of entry. Note that these bullet fragments are all limited to the right side of the brain case. (National Archives)

Fig 28 B:

X-RAY OF
PRESIDENT'S HEAD
FROM THE SIDE

Computerized enhancement of Kennedy's skull X-ray, prepared for the House Assassinations Committee. It shows the type of fragmentation of the skull which reassured me that it was indeed compatible with that to be expected from the powerful type of bullet Oswald fired. The white dots in a row across the top of the skull are bullet fragments, indicating the approximate path of the bullet. (National Archives)

Fig. 29 A

A DRAWING OF KENNEDY HEAD WOUND BASED ON A DETAILED STUDY OF THE ACTUAL X-RAYS

This diagrammatic drawing clarifies the relative sizes and positions of the various components of the head wound, the locations and approximate sizes of the bullet fragments and the tissues, and the magnitude of the damage. It shows that the extent of the damage to the head was appropriate to the considerable power of the weapon the Warren Commission alleged was used by Oswald.

A: The wound of entry. The ovoid wound of entry was fairly high up on the back of the skull, well above the hairline, where the skull starts to curve forward, and about 10cm above the occipital tuberosity. (Oswald came within a few centimeters of missing the President.) The hole in the inner margin of the wound was characteristically larger than the hole in the outer layer of the skull. Large cracks in the skull radiated from this point.

B: This points to a bullet fragment shaved off by the sharp edge of the skull. A fragment (6.5mm in diameter) of the bullet was sheared off by the sharp edge of the thick wound of the skull and was embedded in the margin of the wound of entrance. This fragment was the largest one left in Kennedy's head.

C: Large wound of exit on top of skull. A pentangular portion of the top of the skull, (roughly 15cm X 13cm) exploded upward and forward due to the power of this destructive bullet and was forced 40 feet in the air by the explosion of the brain.

D,E,F: Fragments of the skull. Three fragments of skull picked up in the street in Dallas account for the majority of area of bone that was missing and were clearly the fragments seen leaving the head in a forward and upward direction in frame 313 of the Zapruder movie of the shooting.

G: Everted flap of skull and scalp. An additional flap of skull appeared to be turned outward and was hanging down in front of and above the right ear, but had not become detached. It had 3 tiny metal fragments embedded in it, each about 1 to 2mm in size.

H: Cluster of fragments. An elongated (4cm) cluster of about 19 tiny fragments of bullet in the front of the head was scattered along a line from the front edge of the large head wound of exit back in the direction of the wound of entrance. Four or five similar tiny bullet fragments were embedded in the bone near the front edge of the wound of exit and a "half-round" 1cm notch in the corner of the largest loose fragment of skull also had a crescent of tiny metal particles surrounding it.

I: Bullet fragments in the front of brain. The second-largest metallic fragment (7mm X 3mm but crescentic) had come to rest in the front margin of the brain just above the top of the frontal sinus on the right. A neutron activation analysis showed that this fragment came from the same bullet that struck the inside of the windshield and fell into the seat. Several other tiny bullet fragments are scattered between the wound of entry and the wound of exit. There were no metallic fragments on the left side of the brain case. All the metallic fragments on the right side were in line between the wound of entry and the top of the frontal sinus, and the majority were in the front and top of the brain case.

J: Huge skull fracture lines. Multiple huge fracture lines extended from the margins of the large wound of exit and others from the wound of entrance. These were compatible with the great force exerted by a heavy (161 grain) high-speed (2400 feet per second) military bullet on a thick part of the skull, and if we had <u>not</u> found them it would have raised doubts that Kennedy might have been shot with some other, less powerful type of weapon. These multiple, devastating fractures in the base of the skull were very much in keeping with the type of weapon used by Oswald.

K: Notch in front of scalp wound.

L: Tiny bullet fragments scattered through the head. Other fragments flew high enough to go over the windshield and down the street, while still others hit the inside of the windshield and fell into the front seat of the automobile. (J.K. Lattimer)

Fig 29 B

LATTIMER DRAWING FROM ACTUAL X-RAY OF PRESIDENT KENNEDY'S HEAD - LOCATIONS OF THE BULLET FRAGMENTS IN THE PRESIDENT'S HEAD

A diagrammatic sketch made from an A-P x-ray of Kennedy's head, shows that the locations of all the metallic fragments were confined to the right side of his brain case and that there were no wounds not connected to the principle wounds in the right side of the head. Letters identifying various components of the wound are correlated with the letters in Fig.29A

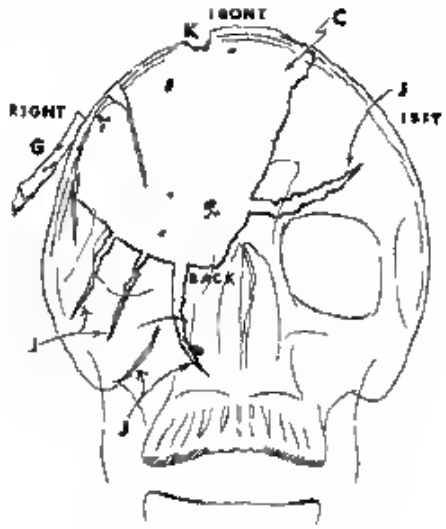


Fig 30

PRESIDENT KENNEDY'S BRAIN WOUND

Drawing of Kennedy's brain after removal of the brain, made for the House of Representatives Select Committee on Assassinations showing that a very large portion of the right hemisphere had been shot away. There was no possibility that he would have survived such an extensive wound. In effect, he was killed instantly by the skull bullet in frame 313. (National Archives)

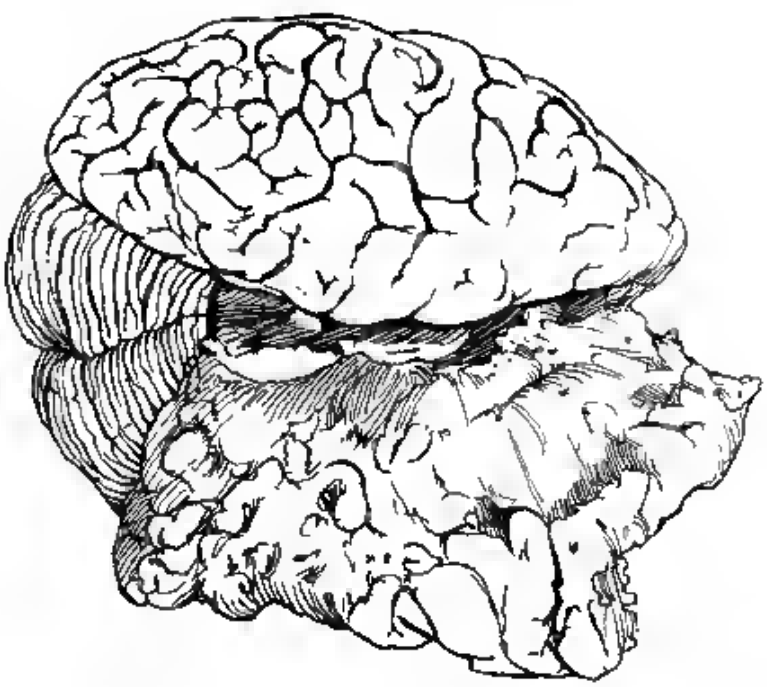


Fig 31:

DUPLICATION OF JFK SKULL WOUND

When we struck our heads at the same spot where the President's skull was struck, the wound was duplicated very closely. Fragments of skull flew upward and forward (see Fig. 28) just as his did in Zapruder frame 313. The fragments flew 30-40 feet in the air, as at Dallas (J.K. Lattimer)

Fig 32

SEVERE SKULL FRAGMENTATION FROM KENNEDY TYPE BULLETS

X-rays of the tops of several of our skulls show the degree of fragmentation caused in each instance by the bursting effect of the high pressures created within the simulated brains, caused by these 6.5mm Carcano fully-jacketed military bullets. This is the degree of fragmentation I had expected to see, based on my experience as a military surgeon in WWII (this was a WWII rifle). (J.K. Lattimer)

WOUND BALLISTICS REVIEW

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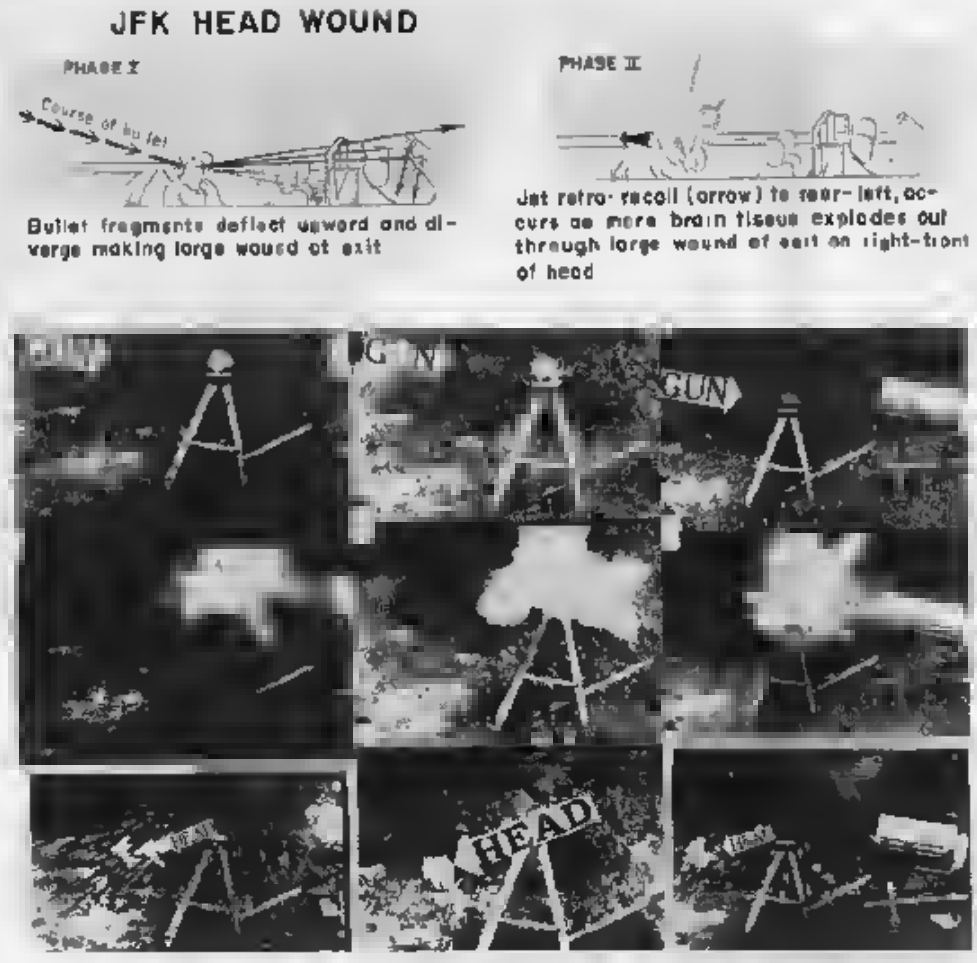

Fig 33

EXPLOSION OF BRAIN WITH RETRO-RECOIL OF HEAD

Backward motion of the head, towards the gun (after an initial forward lurch). This is a jet-recoil from the mass of heavy wet brain substance which explodes out forward, through the larger wound of exit on the front-right of the President's head simulation (3 examples). Note the cloud of vaporized brain substance (mixed with white paint, to improve visibility) hanging in the air to the left of the President. A motorcycle policeman rode into this wet cloud and was covered with brain substance, as were the Connallys.

Because the exit wound is in the right side it also drives JFK over towards his left (towards Mrs. Kennedy) where he falls down on the seat. She rises to one knee to let him fall where she had been sitting. Then the car jerks forward and throws her out full length on the car trunk.

Note that as the exiting bullet fragments diverged (as in the diagram) some hit the partition between the seats and fell to the floor, and other fragments hit the windshield and dropped to the floor near the driver. Still others went over the windshield and down the street, to kick up dust in a spectator's face.

Figure from *Kennedy and Lincoln, Medical and Ballistic Comparisons of Their Assassinations* copyright 1980 John K. Lattimer, reproduced by permission Harcourt, Brace, Jovanovich

Summary

By experimentation, we found that the interesting differences in the performance of the two 6.5mm fully jacketed Mannlicher-Carcano bullets that struck President Kennedy were clearly due to the fact that one (WC 399) first impacted the soft tissue of the President's neck which it traversed without deformity. This intact bullet then yawed striking Governor Connally while traveling sideways. It was bent and flattened from striking Governor Connally's rib in this position. It then perforated his right wrist and entered his left thigh, now traveling backwards, and was stopped by his femur. Anyone who says this bullet is "pristine" is lying to us. It is deformed (bent and flattened) by great force (Fig. 20).

Bullet (No. WC 567.569) which struck the President on the back of the head, broke up because of the hardness of the skull, with the immediate transition into the soft tissue of the brain (Fig. 31 & 32).

It should also be noted that when our tumbling bullets struck a rib of Governor Connally after traversing the neck of President Kennedy, a cloud of rib fragments exited under exited under Connally's right nipple area and pushed his shirt jacket markedly forward, bulging out at least 6 inches, in an obvious and gross distortion. Immediately following this bulge of Connally's jacket and the turning over of his lapel, in frame 224 of the Zapruder movie, the right arms of both the President and Governor Connally reacted instantly and simultaneously. Kennedy's right arm came up into "Thorburn's position" and Connally's right arm (containing his big white Stetson hat) jerked upwards, because of the wound of his right wrist. His white hat becomes obvious in frame 225,226,230 of the Zapruder movie. We also found, in our experimental models, that if we did not fire the bullet through a Kennedy neck first, it did not tumble. Then when it struck Connally's rib it did not shatter the rib but instead it "drilled a small hole through it. Since there were no rib fragments to bulge out the jacket, this bullet did not cause the jacket bulge nor the lapel turnover. This was a further indication that both men had to have been hit by the same bullet in order to cause the lapel and jacket bulge which occurred in frame 224 of the Zapruder movie (Fig. 20).

Having identified the frame (Z 224) at which the bullet went through the two men, one can then count (Zapruder movie frames) backwards to the frame where Connally and others look around towards Oswald's window in response to hearing the first shot (which hit a tree and misses the car completely). This interval turns out to be 3 1/2 seconds, adequate time for Oswald to work the action of his gun and re-acquire his target. When one counts forward, from the neck wound at frame 224, to the head explosion at frame 313, this is 5 seconds. This is plenty of time for Oswald not only to work the action of his gun but to take 2 additional seconds to look onto the back of President Kennedy's head, which he did so accurately. We found this easy to reproduce with 8 1/2 seconds of time available.

It is our conviction that the only way one can determine what actually happens in situations like this one in Dallas is to conduct detailed and repeated experiments using duplicates of the actual ammunition, weapons and fresh tissues. Our findings, enumerated here, lead us to believe that the differences in the behavior of the two bullets (neck bullet WC 399, and head bullet WC 567.569) were to be expected, due to the differences in the tissues struck. That bullet 399 that went through both men at frame Z224 is obviously deformed. It yawed, but took a straight (not a "zig-zag") trajectory between the two men. That both Kennedy and Connally were hit by bullet 399, in frame 224 of the Zapruder movie showing that Oswald had plenty of time to do his deadly deed.

REFERENCES

[1] Avoob Massad. The American Handgunner. The JFK assassination, a shooter's eye view. Mar/April 1993, p. 98.

[2] Ouinn, Prof. Vincent P., Hearing afore the Select Committe on Assassinations, U.S. House of Representatives. Vol. 1, p.491-567. Sept. 6-8, 1978. The lead core from this bullet 399 matches the fragments from Gov. Connally's wrist. The lead from head bullet fragments match the fragments on the floor front of the car. There was no lead from any third bullet.

[3] Lattimer, John K., Kennedy and Lincoln, Medical and Ballistic Comparisons of Their Assassinations. Harcourt Brace Jovanovich, NY 1980, p. 237, bullet 399 tumbled.

[4] Alvarez, Luis, Aphysicist examines the Kennedy assassination film. Lawrence Berkley Laboratory, Univ. California. Preprint # B1 3884 July 1975.